Reaction to Physical & Chemical Agents

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Lecture objectives:

To understanding of different physical and chemical factors affected viruses such as:1-Heat & Cold, 2- Stabilization of Viruses by Salts, 3-pH, 4-Radiation, 5-Photodynamic inactivation, 6-Ether Susceptibility, 7-Detergents, Formaldehyde, Antibiotics & Other Antibacterial Agents.

Assessment: Homework, quizzes, examination, poster and mini-research discussion.

References: **Main textbook:** Medical Microbiology, **Jawetz, Melnick** 26th ed.,2013

Heat & Cold

There is great variability in the heat stability of different viruses.

- Icosahedral viruses tend to be stable, losing infectivity after several hours at 37°C. Enveloped viruses are much more heat-labile, rapidly dropping in titer at 37°C.

-Viral infectivity is generally destroyed by heating at 50–60°C for 30 minutes, exceptions (eg, hepatitis B virus, polyomaviruses).

Viruses can be preserved by storage at deep-freezing temperatures, and some may withstand lyophilization and can thus be preserved in the dry situation at 4°C or even at room temperature. Enveloped viruses tend to lose infectivity after prolonged storage even at -90°C and are particularly sensitive to repeated freezing and thawing.

Stabilization of Viruses by Salts

Many viruses can be stabilized by salts in concentrations of 1 mol/L. The mechanism by which the salts stabilize viral preparations is not known. Viruses are preferentially stabilized by certain salts.

$MgCl_2$, 1 mol/L, stabilizes picornaviruses and reoviruses;
$MgSO_4$, 1 mol/L, stabilizes orthomyxoviruses and paramyxoviruses;
Na_2SO_4, 1 mol/L, stabilizes herpesviruses.

pH

Viruses are usually stable between pH values of 5.0 and 9.0. Some viruses (eg, enteroviruses) are resistant to acidic conditions. All viruses are destroyed by alkaline conditions.

Radiation

Ultraviolet, x-ray, and high-energy particles inactivate viruses. The dose varies for different viruses. Infectivity is the most radiosensitive property because replication requires expression of the entire genetic contents.

Photodynamic Inactivation

Viruses are penetrable to a varying degree by vital dyes such as toluidine blue, neutral red, and proflavine. These dyes bind to the viral nucleic acid, and the virus then becomes susceptible to inactivation by visible light.

Ether Susceptibility

Ether susceptibility can be used to distinguish viruses that possess an envelope from those that do not
As shown in table 29-1

Detergents

Nonionic detergents—eg, Nonidet P40 and Triton X-100—solubilize lipid constituents of viral membranes. The viral proteins in the envelope are released (denatured).
Anionic detergents, eg, sodium dodecyl sulfate, also solubilize viral envelopes; in addition, they disrupt capsids into separated polypeptides.

Formaldehyde

Formaldehyde destroys viral infectivity by reacting with nucleic acid. Viruses with single-stranded genomes are inactivated much more rapidly than those with double-stranded genomes. Formaldehyde has minimal adverse effects on the antigenicity of proteins therefore it has been used frequently in production of inactivated viral vaccines.

Table 29–1. Families of Animal Viruses that Contain Members Able to Infect Humans.

Nucleic Acid Core	Capsid Symmetry	Virion: Enveloped or Naked	Ether Sensitivity	Number of Capsomeres	Virus Particle Size (nm)[1]	Size of Nucleic Acid in Virion (kb/kbp)	Physical Type of Nucleic Acid[2]	Virus Family
DNA	Icosahedral	Naked	Resistant	32	18–26	5.6	ss	Parvoviridae
				72	45	5	ds circular	Polyomaviridae
				72	55	8	ds circular	Papillomaviridae
				252	70–90	26–45	ds	Adenoviridae
		Enveloped	Sensitive	180	40–48	3.2	ds circular[3]	Hepadnaviridae
				162	150–200	125–240	ds	Herpesviridae
	Complex	Complex coats	Resistant[4]		230 × 400	130–375	ds	Poxviridae
RNA	Icosahedral	Naked	Resistant	32	28–30	7.2–8.4	ss	Picornaviridae
					28–30	6.4–7.4	ss	Astroviridae
				32	27–40	7.4–8.3	ss	Caliciviridae
					60–80	16–27	ds segmented	Reoviridae
		Enveloped	Sensitive	42	50–70	9.7–11.8	ss	Togaviridae
	Unknown or complex	Enveloped	Sensitive		40–60	9.5–12.5	ss	Flaviviridae
					50–300	10–14	ss segmented	Arenaviridae
					120–160	27–32	ss	Coronaviridae
					80–110	7–11[5]	ss diploid	Retroviridae
	Helical	Enveloped	Sensitive		80–120	10–13.6	ss segmented	Orthomyxoviridae
					80–120	11–21	ss segmented	Bunyaviridae
					80–125	8.5–10.5	ss	Bornaviridae
					75 × 180	13–16	ss	Rhabdoviridae

Antibiotics & Other Antibacterial Agents

1- Antibacterial antibiotics and sulfonamides have no effect on viruses. Some antiviral drugs are available.

2- Larger concentrations of chlorine are required to destroy viruses than to kill bacteria, especially in the presence of extraneous proteins. For example, the chlorine treatment of stools adequate to inactivate typhoid bacilli is inadequate to destroy poliomyelitis virus present in feces.

3- Alcohols, such as isopropanol and ethanol, are relatively ineffective against certain viruses, especially Picornaviruses.